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Thus it is needless to dispute and differ about new G. Sp. and varieties. Every variety is a deviation which becomes a Sp. as soon as it is permanent by reproduction. Deviations in essential organs may thus gradually become N. G. Yet every deviation in form ought to have a peculiar name, it is better to have only a generic and specific name for it than 4 when deemed a variety. It is not impossible to ascertain the primitive Sp. that have produced all the actual; many means exist to ascertain it: history, locality, abundance, etc. This view of the subject will settle botany and zoology in a new way and greatly simplify those sciences. The races, breeds or varieties of men, monkeys, dogs, roses, apples, wheat . . . and almost every other genus, may be reduced to one or a few primitive Sp. yet admit of several actual Sp. names may and will multiply as they do in geography and history by time and changes, but they will be reducible to a better classification by a kind of genealogical order or tables.

My last work on Botany if I live and after publishing all my N. Sp. will be on this, and the reduction of our Flora from 8000 to 1200 or 1500 primitive Sp. with genealogical tables of the gradual deviations having formed one actual Sp. If I can not perform this, give me credit for it, and do it yourself upon the plan that I trace.

C. S. R.

As we know, Rafinesque never worked out the plan he thus had traced, nor was his pathetic appeal to be given credit for it ever entertained. Call (*l. c.*) regards Rafinesque as a Lamarckian rather than a Darwinian, but we are now, perhaps, warranted to ask whether he was not really a de Vriesian. His curious distinction between 'primitive species' and 'actual species' is more pertinent in this connection than his use of the word 'mutation,' though the coincidence is interesting enough. His 'genealogical tables' also clearly foreshadow the 'phylogenetic tree,' and altogether the whole letter reads singularly prophetic.

I am under obligation to Dr. Theodore Gill for the references to Asa Gray and Darwin.

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WASHINGTON, D. C.,
May 3, 1906.

*In another article in the same journal, p. 173, he says that 'almost every *genuine* or *primitive* species will be found to constitute a peculiar genus.'

THE INFLUENCE OF THE PLASTICITY OF ORGANISMS UPON EVOLUTION.

IN their discussions of 'organic selection,' Morgan, Osborn, Baldwin and others have urged the importance of the plastic response of the individual members of a species in guiding the course of its evolution. I do not see that one can doubt the reality of this influence, but as to the extent and exact character of the influence there seems room for discussion.

In the case of a species whose members are highly plastic, responding promptly and extensively, in certain particular ways, to the modifying influences of the environment, those individuals in which similar adaptive characters later appear as congenital variations will have but slight advantage over the ontogenetically adapted, and selection must be comparatively ineffective. The only advantage to the congenitally adapted will be in the fact that in their early life they have to pass through no period of education, and if the ontogenetic adaptation of other individuals be prompt and sufficient, it seems as if the latter would be at comparatively slight disadvantage. A high degree of plasticity hinders evolution by selection, of characters similar to those acquired by plastic response to the environmental influences.

In the case of a species whose members are but slightly plastic, or are slow in their adaptive response, the congenitally adaptive may have a considerable initial advantage. It is doubtful, however, if slight plastic response will be highly effective in securing the survival of the individuals until the species could become congenitally modified in a similar way.

So far, then, as a single set of characters are concerned, we may say that a high degree of plasticity will probably retard evolution as much or more than it will guide, while slight plasticity, allowing only imperfect ontogenetic adaptation, may be ineffective in preserving the species. The guiding effect of ontogenetic responses upon the course of evolution can hardly be both very extensive and intimate (exact).

As has frequently, though not always, been recognized in discussions of organic selection, the guidance of evolution, through plastic modifications of the individual, is not exact. The frequently used illustration of the forced adoption of an arboreal habit by individuals of a monkey-like species, when environmental conditions became unsuitable for their persistence upon the ground, recognizes that this ontogenetic change of habit will not guide to the evolution of an innate tree-climbing instinct. For example, in Conn's use of this illustration, the tree-climbing habit leads to the survival of individuals which show entirely different congenital adaptation, modifications in foot and hand structure. Here a change to a tree-climbing habit has had a general influence, making all adaptation for life in the trees advantageous. The effect is general and the effect upon evolution is general, not preserving congenital adaptations similar to the first ontogenetic adaptation, but preserving entirely different sorts of adaptations. The effect is vague and general. It is, however, no less real.

In a species whose members are slightly plastic, or slowly responsive to modifying influences, innate characters, similar to those ontogenetically acquired, may be evolved, but in a species whose members are highly plastic and rapidly responsive, the adaptive innate characters which may later be produced, will probably be of a type different from that of those ontogenetically acquired. In other words, the greater the plasticity, the less intimate will be its guidance of the course of evolution, for a rapidly acquired and highly developed ontogenetic adaptation is almost as beneficial as an innate adaptation of the same type.

There is another possible influence of plasticity, which is worth considering. There is some paleontological evidence in favor of a belief that there are definite trends in evolution, due to conditions within the organism, rather than to external factors. I have, in this journal, pointed out¹ that the appearance,

generation after generation, of the same mutants of *Oenothera lamarckiana*, in numbers far greater than could be explained by purely fortuitous variation, is a further indication of some internal control over variation, making it somewhat determinate, instead of purely indeterminate. Weismann's theory of germinal selection is an ingenious explanation of a possible way in which such trends in evolution may arise and persist. I believe there is evidence that well-defined trends in evolution have existed (paleontological evidence) and do exist (evidence from *Oenothera lamarckiana*). This question could be settled by sufficiently prolonged and sufficiently extensive observations in breeding, to see if variations and mutations do tend to be grouped in particular directions rather than to be equally distributed in all directions from the mean.

If it be true that trends in variation (or in evolution, the same thing) do exist, it suggests an interesting consideration in connection with plasticity. If such trends do exist, it is probable that they will appear in a species, persist for a time and ultimately die out. It is, therefore, possible that the adaptability of the individual members of a species might tide the species over a period of disadvantageous environmental conditions, giving time for some new and advantageous trend to appear. Such an effect is not only conceivable; it seems not unlikely that in numerous instances it may have been important.

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March 6, 1906.

A SIMPLE FORMULA FOR MIXING ANY GRADE OF ALCOHOL DESIRED.

THIS problem of mixing different grades of alcohol recurs almost periodically to the worker in biology, but at sufficiently long intervals for him to forget his method. I do not recall, on the other hand, that I have ever seen any wholly satisfactory rule or formula that was simple, easy to remember, and with which one could, at a glance, mix any desired quantity, or having given a certain volume of any grade of alcohol, that one could with readiness change the whole volume into the required

¹ SCIENCE, N. S., Vol. XXI., No. 531, March 3, 1905.